

THAT WHICH IS CLAIMED IS:

1. An opto-electronic device, comprising:
  - a substrate comprising a first III-V semiconductor layer;
  - an electrically insulating layer that extends on the first III-V semiconductor layer and comprises an array of non-photolithographically defined nanopores therein;
  - an array of vertical quantum-dot superlattices in the array of nanopores; and
  - a second III-V semiconductor layer on said array of vertical quantum-dot superlattices.
2. The device of Claim 1, wherein the nanopores in the array have an average diameter in a range between about 8nm and about 50 nm.
3. The device of Claim 1, wherein the first III-V semiconductor layer is an N-type semiconductor layer; and wherein the second III-V semiconductor layer is a P-type semiconductor layer.
4. The device of Claim 1, wherein the first III-V semiconductor layer is an N-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer; and wherein the second III-V semiconductor layer is a P-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer.
5. The device of Claim 1, wherein the first III-V semiconductor layer comprises an N-type GaAs layer and an N-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer on the N-type GaAs layer.
6. The device of Claim 5, wherein said electrically insulating layer comprises an anodized aluminum oxide layer having the array of non-photolithographically defined nanopores therein.

7. The device of Claim 6, wherein each of a plurality of vertical quantum-dot superlattices in the array of nanopores comprises an alternating arrangement of InGaAs and GaAs dots therein.

8. The device of Claim 7, wherein said second III-V semiconductor layer comprises a P-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer that contacts said electrically insulating layer and a P-type GaAs layer that extends on the P-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer.

9. The device of Claim 5, wherein said electrically insulating layer comprises a silicon dioxide layer having the array of non-photolithographically defined nanopores therein.

10. The device of Claim 9, wherein each of a plurality of vertical quantum-dot superlattices in the array of nanopores comprises an alternating arrangement of InGaAs and GaAs dots therein.

11. The device of Claim 10, wherein said second III-V semiconductor layer comprises a P-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer that contacts said electrically insulating layer and a P-type GaAs layer that extends on the P-type  $\text{Al}_x\text{Ga}_{1-x}\text{As}$  layer.

12. An opto-electronic device, comprising:  
an electrically insulating layer having an array of non-photolithographically defined nanopores therein; and  
an array of vertical quantum-dot compound semiconductor  
superlattices in the array of nanopores.

5

13. The device of Claim 12, wherein said electrically insulating layer comprises an anodized aluminum oxide layer.

14. The device of Claim 12, wherein said electrically insulating layer comprises a silicon dioxide layer.

15. The device of Claim 13, wherein each of a plurality of vertical quantum-dot superlattices in the array of nanopores comprises an alternating arrangement of InGaAs and GaAs dots therein.

16. The device of Claim 12, wherein each of a plurality of vertical quantum-dot superlattices in the array of nanopores comprises an alternating arrangement of InGaAs and GaAs dots therein.